Tohoku Univ. Technology

Biological Material Passive Sampler (3D-printable)

Novel technology for applications employing eDNA

Spinner type

Cube type

During coastal surveys, devices collect biological material from the pelagic environment and the benthos

During deep sea surveys, both devices can be affixed to sampling equipment

Seeking partners & Support:
For ongoing development and testing of a “lightweight metal” prototype for use in microplastics capture and assessment.

Overview

Environmental DNA (eDNA) sampling and analysis, used to monitor the presence and marine biodiversity (species composition), is widely applied by marine ecologists, government environmental agencies, fisheries and aquaculture, and deep-sea research expeditions. Conventional active eDNA sampling requires transporting water collected on site to the lab for filtration with electric powered vacuum pumps, or peristaltic filtration in situ, leading respectively to DNA degradation and ecosystem disturbance. In contrast, these two Biological Material Samplers passively collect material (eDNA, eRNA, microbes) from the water column or the benthos, respectively. They are simple to assemble, deploy, and retrieve, for both shallow coastal and deep-sea surveys down to 6000m depth. In field trials at a fishing port in Miyagi Prefecture, eDNA collected with these devices was used to validate the presence/absence of four octopus fishery target species across different seasons during a 2-year study, demonstrating the device‘s potential to transform marine biomonitoring efforts.

Potential Applications

- ☐ Fisheries target species seasonal biogeographic monitoring
- ☐ Aquaculture: early detection of pathogens & invasive species
- ☐ Ecological assessment in the event of disasters

IP Data

IP No. : JP 2026-40974
Inventors : Cheryl L. Ames, Matthijs Ledder
Reference No. : T26-023

Features・Outstandings

Criteria	Our Technology	Existing Technology
Filter fixation	**Snap together two pieces holding appropriate filter membranes type (e.g., eDNA, RNA, organic matter, microbes, cells)**	Transporting large volumes of water to a lab for active filtration, or filtering small quantities of water through commercial syringe filtration systems
Durability / loss risk	**Electricity not required; Few moving parts, low breakage**	Electric filtration system required which is expensive
Fabrication / cost	**Rapid, low-cost mass-production with 3D printer facilitating surveys and sample processing by stakeholders**	Filtration system belongs to the researcher, precluding onsite sample processing by non-affiliated stakeholders
DNA yield	**Suffient eDNA yield for metabarcoding of samples from inshore and oceanic surveys collected from surface to 6000m depth**	Efficiency in deep-sea environments still untested due to mechanical and electricity constraints
Assembly	**Fast**	Time-consuming
Pressure resistance	**Safely tested in situ down to 6000 m depth**	Deep-sea performance testing not feasible

Contact

Tohoku Techno Arch Co., Ltd.
Please visit CONTACT here

PASSIVE SAMPLERS for AQUATIC BIOLOGICAL MATERIAL

3D-printable, electricity-free biomonitoring technology for coastal and deep-sea surveys, successfully tested to 6,000m depths for eDNA applications

eDNA SAMPLING: PASSIVE VS. ACTIVE

✦ Electricity & Onsite Feasibility

Power-Free (Passive)
Collects eDNA from the benthos or water column without electricity.

Requires Electric Pump
Requires filtration of large volumes of water by vacuum; peristaltic pumps cause ecosystem disturbance.

✦ Deployment Depth

Deep-Sea Ready (0-6000m)
Hydrodynamically designed and successfully tested at depths down to 6000m.

Limited depth tested
Deep-sea deployments are mechanically complex, expensive, and untested.

✦ Cost & Accessibility

Low-Cost 3D Printing
Rapidly mass-produced with standard 3D printers, enabling onsite deployment by any stakeholder.

Researcher-Exclusive
High equipment cost and specialized training limits use to affiliated scientists, omitting stakeholder involvement

NOVEL PASSIVE SAMPLERS: TWO DESIGNS BY APPLICATION

1. Pelagic eDNA Sampler

Designed for water column/pelagic surveys, collecting from coastal to deep oceanic waters. Optimized for easy attachment to tethered rope or wires, CTDs, Marine Snow Cathers or Plankton Nets.

• *Features: Slender, integrated handles, tight-fitting lid with dividers for specific filter membrane types (e.g. eDNA, RNA, microbes)*

2. Benthic eDNA Sampler

Specially engineered for ecological surveys on the seafloor/benthos. Easily affixes to sampling equipment, ROVs, or landers, offering outstanding durability against wear.

• *Features: Rigid grid frame, optimized flow channels, and side slots for rapid in-field assembly of filter membranes (e.g. eDNA, RNA, microbes).*

★ Deployment: Snap in filter → Deploy → Recover → Extract

FIELD TRIAL & CO-DEVELOPMENT

✓ Validated Field Performance
A 2-year seasonal study at a fishing port in Miyagi Prefecture successfully validated the presence/absence of 4 octopus fishery target species, supporting collection yield sufficient for metabarcoding.

➔ Future: Microplastics Capture
Currently developing a new "lightweight metal" prototype (Cube & Spinner designs) tailored specifically for microplastics capture and organic matter assessment.

✉ Seeking Partners & Support
Provisional Patent IP No. 2026-40974 (Tohoku Univ. / Inventors: Cheryl L. Ames, Matthijs Ledder). Managed by Tohoku Techno Arch Co., Ltd. for licensing and co-development inquiries.

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